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NORTH AMERICAN RHABDOCOELA AND ALLOEOCOELA. III[1]

MESOTOMA ARCTICA, N.SP., FROM NORTHERN CANADA

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During a collecting expedition to the tundra near Churchill, in northern Manitoba, Canada (58° north latitude), in the summer of 1936, Mr. H. Elliott McClure of Peru, Illinois, secured large numbers of a mesostomid rhabdocoel which were sent to me for identification. Mr. McClure has written an interesting account of his collecting experiences on the tundra in The Beaver for March, 1937.

The rhabdocoel was found to be an undescribed species of *Mesostoma*, which is here named *Mesostoma arctica*. The material was not in very good histological condition and hence I am not able to furnish a detailed account of the histology. For the anatomy and histology of the mesostomids the splendid account of Luther (1904) constitutes a standard and the present species has been compared chiefly with his descriptions and figures. Gelei's recent redescription (1933) of *Mesostoma productum* has also proved helpful.

Mesostoma arctica, new species

Figures 1 to 5

EXTERNAL CHARACTERS.—The species attains a length of 4–5 mm. in life according to Mr. McClure but the preserved specimens were mostly about 3 mm. in length. The color is grayish brown or brown. The shape differs from that of other species of *Mesostoma* (Fig. 1). The anterior end is broad and blunt, almost truncate, and has a central depression bordered on either side by a projecting lip. From the anterior end the body width diminishes gradually to a slender tail; in preserved specimens this narrow tail is often sharply set off from the plump body but this seems not to be the case in life. The preserved specimens frequently showed angular margins but according to Mr. McClure these are not present in life but the animal is simply flattened below, con-

[1] The first and second papers of this series of articles were published in the Trans. Amer. Micro. Soc., LV, 1936, pp. 14–20, and in the American Museum Novitates, No. 1004, 1938.

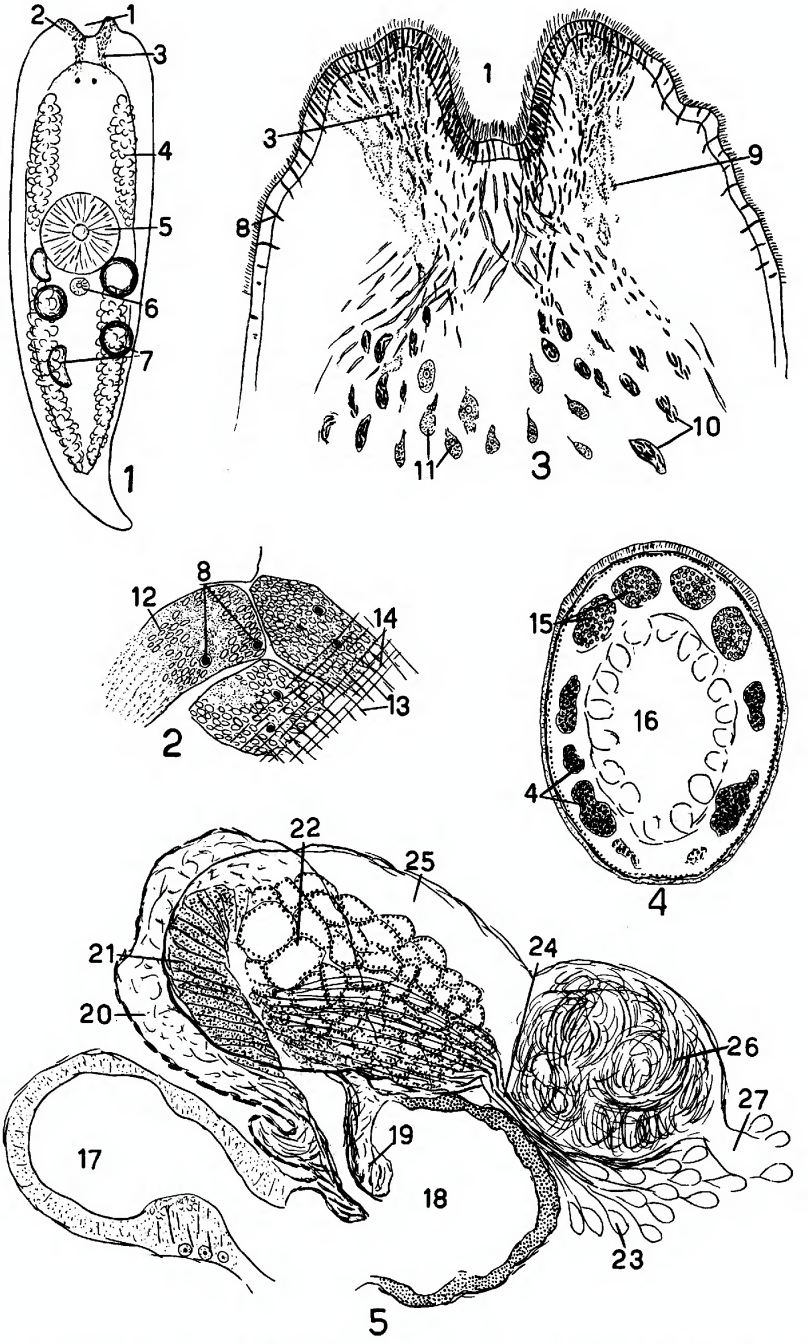

Fig. 1. *Mesostoma arctica*, new species, constructed from several preserved specimens.

Fig. 2. Frontal section through anterior end to show anterior pit and rhammite tracts.

Fig. 3. Epidermal cells seen in tangential section, surface to the left, subepidermal musculature to the right.

Fig. 4. Transverse section to show location of testes and yolk glands.

Fig. 5. Male apparatus seen in sagittal view, anterior end of animal to the right.

vex above. Cross-sections of the preserved worms were more or less circular, no doubt because of contraction on killing. Owing to the dark color very little of the internal anatomy could be made out on cleared stained or unstained whole specimens. There is a pair of eyes some distance behind the anterior pit and four elongated clusters of yolk glands could be seen, an anterior and a posterior cluster in lateral regions on each side. All the larger specimens contained several resting eggs in the posterior half of the body. These appeared dark brown in color in the preserved worms, but were stated by Mr. McClure to be a bright purplish red in life. In the preserved whole animals and in sections the eggs are hemispherical; this shape may be the result of collapse but this seems improbable because of the hard shells.

General Histology.—The surface is clothed with a ciliated cellular-epidermis which, so far as could be determined, closely accords with Luther's account. The epidermis is taller over the anterior end (Fig. 3) and dorsal surface (Fig. 4) than elsewhere. The structure of the epidermal cells is best seen in places where they happen to be cut tangential to the surface. Such sections show that the epidermal cells are large polygonal cells (Fig. 2) sharply marked off from each other, and filled with rhabdites of two sorts. One kind, termed rhammites by von Graff, is larger than the other and long and slender and somewhat sinuous. Each epidermal cell contains two or three to several such rhammites which are much longer than the cells and so extend into the underlying parenchyma (Fig. 3). The smaller rhabdites pack the basal half of the epidermal cells; they are said to originate within the epidermal cells while the rhammites come from special glandlike cells located in the parenchyma (Fig. 3). The distal part of the epidermal cells is finely granular and free from rhabdites. At their bases the epidermal cells appear to be continuous with the subepidermal circular muscle layer (Fig. 2).

The chief point of interest in the histology concerns the anterior depression or pit (Fig. 3). This was found to be simply a depression lined by epidermis differing from the adjacent epidermis of the anterior end only in that its cilia are noticeably longer. The pit is therefore probably in part a sense organ. The sides of the pit and also the bordering liplike projections differ further from the epidermis elsewhere in the large number of rhammites which penetrate them (Fig. 3). These rhammites are in fact the ends of two rhammite tracts ("Stäbchenstrassen" of German writers) which extend inward a short distance to their origin in clusters of rhammite-forming cells. Such single or paired anterior

rhabdite tracts are of common occurrence in the genus *Mesostoma*. In *M. arctica* as also in other mesostomids the rhammite tracts are accompanied by the netlike outlets of cyanophilous glands whose bodies occur near the rhammite-forming cells. In preparations stained with Mallory's triple stain, the contrast between the red rhammites and rhammite-forming cells and the deep blue strands of the outlets of the cyanophilous glands is very striking. The cyanophilous gland cells themselves take a rather pale color in Mallory's stain and are filled with droplets and vacuoles.

In some mesostomids (as *Rhynchomesostoma rostratum*, *Mesostoma rhynchotum*, and *M. nigrirostrum*) there is at the anterior tip a small protrusible snout which can be withdrawn, thereby causing the formation of an anterior pit similar to that of *M. arctica*. The snout is then seen as a projecting eminence in the bottom of the pit. I could not find in *M. arctica* evidence of any such protrusible snout associated with the anterior pit but the general histology of the pit and bordering lips in *M. arctica* is similar to that of the snout and pit in the species mentioned and presumably serves the same purpose, namely, acting as a sensory and adhesive organ in the capture of prey. The muscular attachments of the pit of *M. arctica* indicate that the pit is protrusible to at least some extent.

Internal to the epidermis is found the usual subepidermal muscle sheath, consisting of outer circular and inner longitudinal fibers. Diagonal fibers, mentioned by Luther as common in mesostomids, appeared to be absent. A considerable number of muscle fibers are attached to the bottom of the pit. The condition of the preparations did not permit me to follow these very well but most seemed to proceed diagonally toward the ventral surface, there to join the subepidermal muscle sheath, while some coursed dorsally.

The parenchyma is in poor histological condition in all of the available series of sections.

Systems Other than the Reproductive System.—Owing to the poor state of the material no attempt was made to study the nervous, excretory, or digestive systems. The two main excretory ducts could be found and had the relations typical of the genus *Mesostoma*, that is, they run transversely and open into the pharyngeal pouch. The mouth has the usual mid-ventral location and opens into a pharyngeal pouch (Fig. 6) to which is attached the typical rosette pharynx. The structure of the latter has been fully described by Luther and his predecessors and

that of *M. arctica* appears to conform in all details to that of other mesostomids.

Reproductive System.—This system naturally follows in the main the plan of other mesostomids but shows a number of specific peculiarities. The testes are follicular consisting of numerous follicles situated along the mid-dorsal region for the entire length of the worm except the tail. In every cross-section (Fig. 4) several testis follicles are found. Their connections with the vas deferens were not seen. The numerous yolk glands occur in the lateral body regions ventral to the testes and as already remarked are arranged in four elongated clusters, two on each side anterior to the pharynx and two similarly situated behind the pharynx. The mid-ventral region is free of yolk glands (Fig. 4).

The copulatory complex (Figs. 5 and 6) is similar in its general plan to that of other species of *Mesostoma.* The common genital atrium joins the pharyngeal pouch to form a common chamber leading directly to the mouth, which thus also serves as genital pore. The genital atrium is a large cylindrical canal lined by a tall epithelium and provided externally with first circular and then longitudinal muscle layers. At its upper or dorsal end it receives on the right side the female organs, on the left the male organs, and posteriorly the uteri. In figure 6, an attempt has been made to show the entire copulatory complex in sagittal view with the female parts filled in and the male parts indicated in outline only. The details of the male parts are given in figure 5.

The male parts consist of anterior and posterior pouches of unknown function and a median penis continuing anteriorly into a granule vesicle and a seminal vesicle (Fig. 5). The penis is divisible as usual into a small penis papilla projecting into the roof of the genital atrium and a pyriform penis bulb. The detailed histological structure of these parts could not be ascertained exactly but appeared to correspond to Luther's and Gelei's descriptions. The penis papilla has muscular walls and probably a thickened cuticular lining, although the latter was not clearly seen. The penis bulb is covered externally with muscle fibers and receives two sorts of secretions. Its posterior wall has elongated chambers, bounded by what appear to be muscular partitions and filled with granules of cyanophilous secretion. Its anterior wall consists of large spaces bearing droplets of eosinophilous secretion. Both these regions are continuous with a large fusiform vesicle which I consider to be a granule vesicle. *Mesostoma arctica* appears to differ from all other species of *Mesostoma* in having a large granule vesicle distinct from both penis bulb and seminal vesicle. In other species, penis bulb, granule

secretion, and seminal vesicle form together one bulb-shaped organ. The granule vesicle of *M. arctica* like the penis bulb contains two sorts of glandular secretion. Its ventral and central parts are made of cyanophilous secretion and is continuous posteriorly with the posterior cyanophilous wall of the penis bulb, and anteriorly with a conspicuous cluster of granule glands (Fig. 5). These granule glands occur below and behind the seminal vesicle; their ducts run forward in a bundle below the seminal vesicle and enter the anterior end of the granule vesicle at the junction of the latter with the seminal vesicle. The ducts inside the granule vesicle and penis bulb widen out into the elongated chambers filled with cyanophilous granules already mentioned. It thus appears that these chambers are the terminal parts of the ducts of the granule glands. The dorsal and lateral portions of the granule vesicle are occupied by large spaces bordered by droplets of eosinophilous secretion. This part of the granule vesicle is continuous with the similar spaces in the anterior wall of the penis bulb. The source of this eosinophilous secretion could not be determined; presumably the spaces must be connected with gland cells but none were found although such are said by Luther to be present.

At its anterior end the granule vesicle opens into the seminal vesicle, a rounded chamber packed with a mass of sperm and receiving the vas deferens at its anterior end. Both granule vesicle and seminal vesicle have muscular walls but no definite lining epithelium could be made out.

The female parts are similar to those of other species of *Mesostoma*. They comprise a copulatory bursa and the main female tract. The former is a round sac with a muscular wall inclosing a mass of sperm; it connects to the most anterior part of the dorsal roof of the common atrium by means of a curved duct. The copulatory bursa of *M. arctica* differs from that of most other species of *Mesostoma* in its rounded form and slender duct. In some of the specimens sectioned, the bursa was much larger than in the series from which Fig. 6 was drawn. The main female tract begins as a large duct entering the right posterior part of the roof of the genital atrium. It proceeds dorsally and then curves anteriorly to terminate near the pharynx in the ovary. The ovary as in other mesostomas is a small body containing flattened eggs and is continuous with the very characteristic oviduct composed of extremely flattened cells. Following the oviduct comes an expanded sac, the seminal receptacle, packed with sperm and larger in some specimens than shown in figure 6. Its oviducal end is encircled by large glands. From the

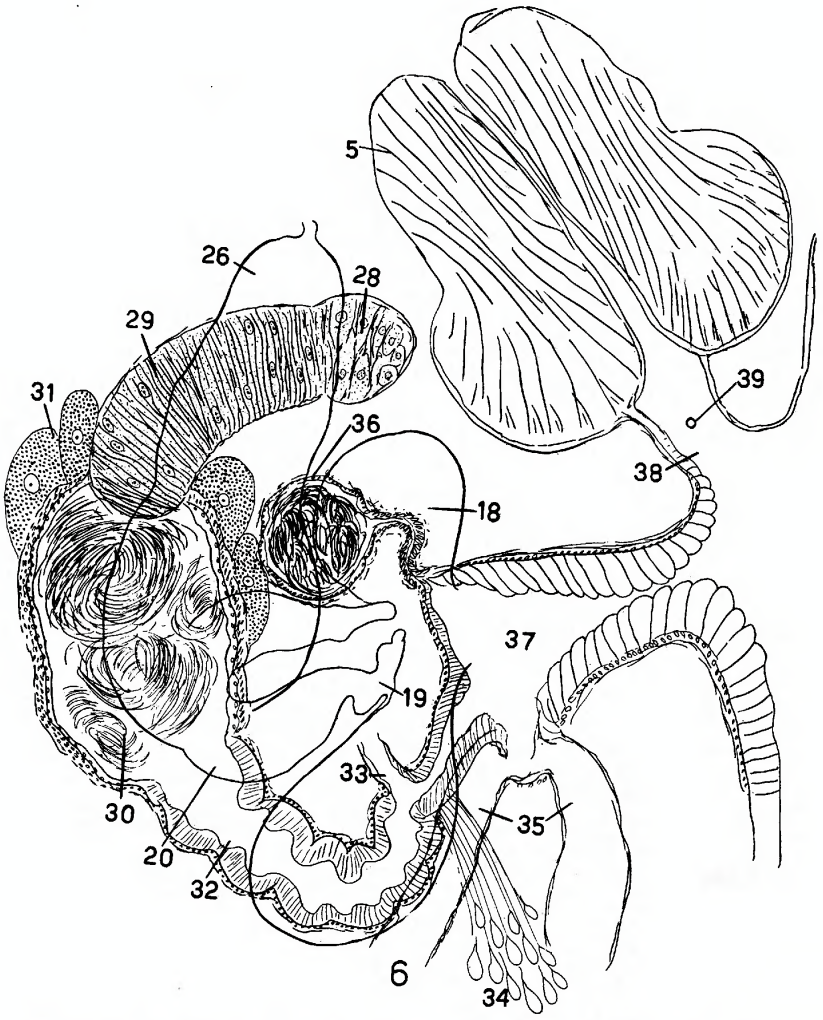

Fig. 6. *Mesostoma arctica*, new species. Sexual complex in sagittal view, constructed from several sagittal sections, anterior end of worm to the right.

1, anterior pit; 2, bordering lips of same; 3, rhammite tracts; 4, yolk glands; 5, pharynx; 6, genital atrium; 7, resting eggs; 8, rhammites; 9, outlets of cyanophilous glands; 10, rhammite-forming cells; 11, cyanophilous glands; 12, small rhabdites; 13, circular, and 14, longitudinal muscle fibers of subepidermal sheath; 15, testes; 16, intestine; 17, posterior pouch, and 18, anterior pouch of male part of atrium; 19, penis papilla; 20, penis bulb; 21, cyanophilous part of penis bulb; 22, eosinophilous part of penis bulb and granule vesicle; 23, granule glands; 24, bundle of their ducts; 25, granule vesicle; 26, seminal vesicle; 27, vas deferens; 28, ovary; 29, oviduct; 30, seminal receptacle; 31, gland of same; 32, common female duct; 33, yolk duct; 34, shell glands; 35, uteri; 36, copulatory bursa; 37, common genital atrium; 38, pharyngeal pouch; 39, entrance of excretory duct into same.

seminal receptacle the common female duct curves ventrally to enter the genital atrium receiving just before this entry the yolk duct into its anterior wall and a cluster of shell glands into its posterior wall. The yolk duct proceeds anteriorly above the male apparatus but could not be traced very far.

The two uteri enter the posterior wall of the genital atrium just below the entrance of the common female duct. Each proceeds transversely and then turns posteriorly to run backwards in the lateral region of the body. The uteri are thus limited to the posterior half of the body and do not have anterior extensions as in some mesostomas. Each uterus in the fully-grown worms contained several conspicuous thick-shelled resting eggs. As already noted these have hemispherical shells.

HABITAT.—The worms were found in abundance in fresh-water pools on the tundra near Churchill, northern Manitoba, Canada, near the arctic circle (latitude, 58° N.), during July, 1936. These pools are either frozen or dry during the greater part of the year. Presumably the mesostomas hatch from the resting eggs as soon as water appears in the pools in June, grow up quickly to maturity, and produce an abundance of resting eggs which are destined to hatch the following spring.

Type: Cat. No. 263, American Museum of Natural History.

SUMMARY.—*Mesostoma arctica*, a new species from northern Manitoba, Canada, is distinguished from other species of *Mesostoma* by the truncate anterior end with a central depression whose sides receive the rhammite tracts, by the spherical form and slender duct of the copulatory bursa, by the presence of a distinct large granule vesicle interpolated between the seminal vesicle and the penis bulb, and by the separate entrances of granule glands and vas deferens into the male apparatus, the former entering the granule vesicle, the latter the seminal vesicle.

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